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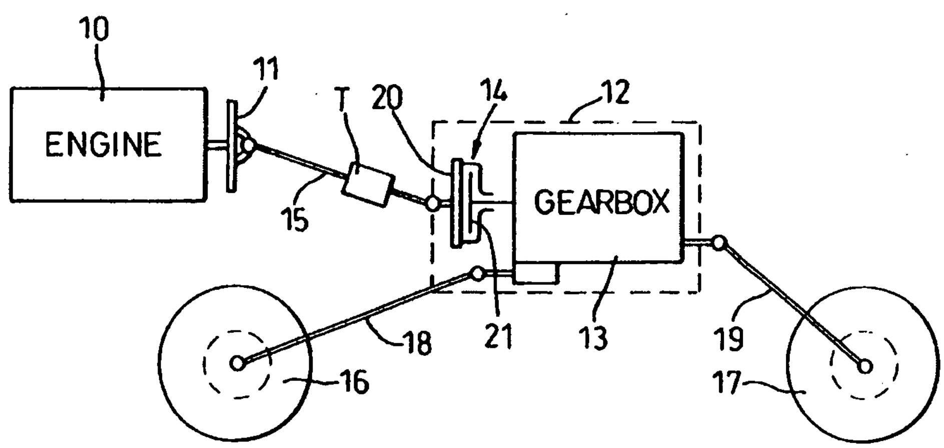

(57) Abstract

A vehicle driveline having a prime mover (10), a first flywheel mass (11) associated with the prime mover, a transmission unit (12) which includes a main drive clutch (14), a first driveline portion (15) which connects the first flywheel mass with the transmission unit, and a second driveline portion (18, 19) which connects the transmission unit with ground engaging wheels (16, 17). The first driveline portion (15) includes a torsionally resilient means (T) operative to damp torsional vibrations, shocks and noise. Driveline arrangements including continuously variable transmission units (61) are also disclosed.

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TORSIONALLY RESILIENT MEANS IN VEHICLE DRIVELINES

This invention relates to vehicle drivelines and in particular to the suppression of noise and vibration in such drivelines.

It is an object of the present invention to provide an improved form of vehicle driveline which offers improved noise and vibration suppression.

Thus according to the present invention there is provided a vehicle driveline comprising:-

a prime mover (engine),
a first flywheel mass associated with the prime mover,
a transmission unit which includes a main drive clutch,
a first driveline portion which connects the first flywheel mass with the transmission unit,
a second driveline portion which connects the transmission unit with ground engaging drive means (wheels), and
torsionally resilient means operative in the first driveline portion to damp torsional vibrations, shocks and noise therein.

The transmission unit may be located remote from the prime mover.

A second flywheel mass may be provided, for example as part of the main drive clutch, and the torsionally resilient means is operative between the two flywheel masses.

The torsionally resilient means may form part of drive shafts, drive tubes, joints, gears or couplings used in the first driveline portion. Other alternative forms of resilient means include spring-centre couplings of the type used in the centre of clutch driven plates or twin mass flywheels, rubber/metal bonded couplings, hydrostatic springs and devices using electro-rheological fluid. Speed sensitive linkages may also be employed as the torsionally resilient means for example the speed sensitive linkage devices disclosed in the Applicant's patent GB 2229793.

A friction or viscous damping device may also be provided in the first driveline portion in parallel with the torsionally resilient means to damp torsional vibrations and shocks.

The friction or viscous damping device may comprise a single stage damping unit or multi-stage damping unit i.e. a unit which offers a multiple of different damping levels dependent on the amount or torsional deflection allowed by the torsionally resilient means.

The second driveline portion may drive a single driving axle or may drive two or more such axles as in, for example, a four wheel drive vehicle.

The invention also provides a vehicle driveline comprising:-

a prime mover (engine),

a first flywheel mass associated with the prime mover,

a continuously variable transmission unit,

a first driveline portion which connects the first flywheel mass with the transmission unit,

a main drive clutch,

a second driveline portion which connects the transmission unit with ground engaging drive means (wheels), and

torsionally resilient means operative in one of said driveline portions to damp torsional vibrations, shocks and noise therein, said torsionally resilient means comprising one or more speed sensitive linkages acting between relatively rotatable parts of said one driveline portion, the or each linkage including a centrifugal mass which tends to adopt a particular orientation when said one driveline portion rotates and which is displaced from said orientation against said centrifugal action when relative rotation occurs between said driveline parts to provide a driveline with a torsional stiffness proportional to the speed of rotation of the driveline.

The present invention will now be described with reference to the accompanying drawings in which:-

Figure 1 shows the basic layout of a fourwheel drive vehicle which includes a driveline in accordance with the present invention;

Figure 2 shows a longitudinal section through one form of torsionally resilient means for use in the present invention;

Figure 3 is a section on the line A-A of figure 2;

Figure 4 shows part of an alternative speed sensitive linkage-type torsionally resilient means for use in the present invention;

Figure 5 is a view in the direction of arrow B of figure 4;

Figures 6 and 7 show alternative forms of vehicle driveline in accordance with the present invention which includes a continuously variable transmission, and

Figure 8 shows a diagrammatic representation of a portion of a driveline in accordance with the present invention.

Referring to figure 1 the vehicle comprises a prime mover in the form of an internal combustion engine 10 which is provided with a first flywheel mass 11 which is directly connected to the engine crankshaft. The prime mover drives a transmission unit 12 which includes a gearbox 13 and a main drive clutch 14. The transmission unit 12 is located remote from the engine 10 and is driven from the engine via a first driveline portion 15.

Ground engaging front wheels 16 and rear wheels 17 are driven from the transmission unit by second driveline portions 18 and 19 respectively.

Main drive clutch 14 includes a second flywheel mass 20 against which the driven plate 21 of the clutch 14 is engaged in the normal manner. This second flywheel mass 20 also acts as a heat sink for the main drive clutch.

In accordance with the present invention torsionally resilient means, indicated diagrammatically at T in figure 1, are provided in the drive connection between the first flywheel mass 11 and the second flywheel mass 20.

This torsionally resilient means T may take many possible forms. For example, as shown in figures 2 and 3, the first driveline portion 15 may directly incorporate a torsionally resilient element 25 which allows portions from the driveline to rotate relative to each other in a torsional manner through a limited angular range. In the arrangement of figure 2 and 3 the resilient element 25 which is formed from rubber is located between two coaxial parts 15' and 15" of driveline portion 15.

Alternatively this ability to allow a limited amount of torsional deflection in the driveline may be incorporated in any other part of the driveline connection between the two flywheel masses 11 and 20 such as, for example, in universal joints, gears or couplings used in this driveline portion.

An alternative method of incorporating rotational torsional resilience in the driveline is to use a spring centre coupling of the type conventionally used in the centre of a clutch driven plate in which coil springs are loaded in compression. The springing arrangement used in certain twin mass flywheels, such as that shown in DE 3546939 and DE 3721710, may also be used which allows relative large rotations between driveline parts 15' and 15" e.g. typically 90 to 120 degrees. Other alternatives include metal/rubber bonded units, hydrostatic springs (e.g. where fluid is moved between chambers via restrictions) and devices using electro-rheological fluid to resist relative rotation of two parts of the driveline..

Speed sensitive linkages of the form disclosed in the Applicants Patent GB2229793 may also be employed as the torsionally resilient means. An example of such a linkage 60 is shown in figures 4 and 5 in which driveline portion 15 includes an input element 50 connected with driveline part 15' and an output element 51 connected with driveline part 15". A plurality of linkages (typically three or four linkages) extend between the input and output elements. Each linkage comprises a bob weight 52 pivotted at 53 on output element 51 and 1 pair of links 54a, 54b which are pivotted on input element 50 via an elastomeric torsion unit 55 at 57 and are pivotally interconnected with bob weight 52 at 56.

Under no-load conditions with the clutch 14 disengaged centrifugal force acts on the pivotal linkages and particularly on the bob weights 52 and urges the linkages in a radially outward direction with pivot 56 adopting a position radially outboard of pivot 53 as shown in figure 4 (this position is regarded as the neutral position between the drive and over-run condition of

the driveline). At higher rotational speeds the centrifugal force is greater and whilst this does not affect the configuration under no-load conditions it greatly affects the force required to rotate the driveline part 15' relative to the driveline part 15" (i.e. the torsional stiffness of the driveline).

If the clutch 14 is engaged and power is transmitted in the drive direction from flywheel mass 11 to flywheel mass 20 there is a tendency for the two driveline part 15' and 15" to rotate relative to each other (input element 50 rotates clockwise relative to output element 51 when viewing figure 4). At relatively low speeds, when the influence of centrifugal force is smaller, the driveline parts 15' and 15" move relative to each other i.e. the driveline torsional stiffness is relatively low. However at relatively high speeds the influence of centrifugal force is much greater and relative rotation of the driveline parts 15' and 15" requires greater force i.e. the torsional stiffness of the driveline is relatively high. Thus the driveline torsional stiffness is speed sensitive. Typically the relative rotation allowed between driveline parts 15' and 15" by linkages 60 is 30 to 50 degrees.

If the clutch 14 is engaged and power is transmitted in the over-run direction from flywheel mass 20 to flywheel mass 11 the effects are similar to the above except that the direction of relative rotation is reversed (input element 50 rotates anticlockwise relative to output element 51 when viewing figure 4) and the bob weight 52 folds between the pair of links 54a, 54b.

The relative rotation between input element 50 and output element 51 is also controlled by the torsion unit 55 of each linkage. Torsion unit 55 comprises a disc 55a of elastomeric material which is bonded on one side to link 54a and on its other side to a plate 58 which is secured to input element 50 at 59. Thus any relative rotation between input element 50 and output element 51 causes link 54a to twist relative to plate 58 about pivot 57 to load elastomeric disc 57 in torsion.

The flywheel masses 11 and 20 described above and the intermediate torsionally resilient means can be considered together to define, in effect, a twin mass flywheel and any of the control and damping arrangements conventionally used in such twin mass flywheels may be employed between these two flywheel masses.

Although the main drive clutch 14 is shown as being positioned on the engine side of the gearbox 13 the clutch could be incorporated within the gearbox drive train at some other location. In this event the clutch could, for example, comprise a multi-plate hydraulically engaged clutch which would no longer require to include the second flywheel mass 20. Such an arrangement is shown in figure 6 in which a speed sensitive linkage type torsionally resilient means 60 (similar to that described above in relation to figures 4- and 5) connects flywheel 11 with a continuously variable transmission 61 which drives an output shaft 62 via an epicyclic reversing gear 63 which includes a main forward drive clutch 64 which locks-up epicyclic gear 63 to provide forward drive and which also includes a reverse brake 65 which when engaged provides reverse drive via epicyclic gear 63.

Alternatively, as shown in figure 7, epicyclic gear 63 with main drive clutch 64 and reverse brake 65 could be positioned between torsionally resilient means 60 and the continuously variable transmission 61. Also, in the arrangement shown in figure 7, the torsionally resilient means may include a second flywheel mass 20 so that a twin mass flywheel unit is formed by masses 11 and 20 and the speed sensitive linkages 60 which interconnect these masses.

As a further alternative the torsionally resilient means 60 may be located in the driveline on the output side of the transmission as, for example, a unit similar to that shown in figures 4 and 5.

To control the limited torsional rotational ability built into the drive connection between flywheel masses 11 and 20 a damping device may also be employed in parallel with the torsionally resilient means.

This damping device may comprise a single or multiple stage unit offering either a single level of damping or multiple levels of damping dependent on the amount of torsional deflection which takes place with the level of damping increasing as torsional deflection increases. This damping device is indicated diagrammatically at D in Figure 8 where the torsionally resilient means is shown at T. A practical example of such a damping device is shown at 66 in figure 6 in the form of a multi-plate friction device acting between the input element (flywheel 11) and output element 68 of the torsionally resilient means.

Any of the well known dry friction damping devices such as multi-plate hysteresis packs etc of, for example, the type described in the applicant's co-pending application number PCT/GB96/00675 may be used. Alternatively viscous damping devices using grease or other appropriate viscous fluid may be employed.

As will be appreciated, the torsional resilience provided in the driveline must be such that the driveline still has remaining torsional resilience at the maximum torque capacity of the prime mover.

Also, by locating the clutch remote from the engine adjacent the gearbox the vehicle manufacturer is allowed more flexibility regarding packaging of the vehicle and is provided with additional space immediately adjacent the prime mover.

CLAIMS

1. A vehicle driveline comprising:-

   a prime mover,

   a first flywheel mass associated with the prime mover,

   a transmission unit which includes a main drive clutch,

   a first driveline portion which connects the first flywheel mass with the transmission unit,

   a second driveline portion which connects the transmission unit with ground engaging drive means, and

   torsionally resilient means operative in the first driveline portion to damp torsional vibrations, shocks and noise therein.

2. A driveline according to claim 1 in which a second flywheel mass is provided and the torsionally resilient means is operative between the two flywheel masses.

3. A driveline according to claim 1 or 2 in which the torsionally resilient means comprises an elastomeric torsionally resilient element positioned between two parts of the first driveline portion which allows limited angular rotation between said parts to provide said damping.

4. A driveline according to claim 3 in which the elastomeric torsionally resilient element is located between two coaxial parts of the first driveline portion.

5. A driveline according to claim 3 in which the elastomeric torsionally resilient means is incorporated in a universal joint or other coupling which forms part of the first driveline portion.

6. A driveline according to claim 1 or 2 in which the torsionally resilient means comprises a spring-centre coupling acting between two parts of the first driveline portion, the coupling including coil springs which are loaded in compression when said parts of the first driveline rotate relative to each other.

7. A driveline according to claim 1 or 2 in which the torsionally resilient means comprises a hydrostatic spring device acting between two parts of the first driveline portion in which fluid is moved between chambers via a restriction.

8. A driveline according to claim 1 or 2 in which the torsionally resilient means comprises a device in which electro-rheological fluid is used to resist relative rotation of two parts of the first drive line portion.

9. A driveline according toclaim 1 or 2 in which the torsionally resilient means comprises one or more speed sensitive linkages acting between relatively rotatable parts of said first driveline portion, the or each linkage including a centrifugal mass which tends to adopt a particular orientation when the first driveline portion rotates and which is displaced from said orientation against said centrifugal action when relative rotation occurs between said driveline parts to provide a driveline with a torsional stiffness proportional to the speed of rotation of the driveline.

10 A driveline according to any one of claims 1 to 9 in which a friction or viscous damping device is provided in parallel with the torsionally resilient means.

11. A driveline according to claim 10 in which the damping device is a single stage unit.

12. A driveline according to claim 10 in which the damping device is a multi-stage unit which provides a plurality of different damping levels dependent on the torsional deflection of the resilient means.

13. A driveline according to any one of claims 1 to 12 in which the transmission unit is a continuously variable unit with the main drive clutch located on the output side of the transmission.

14. A driveline according to any one of claims 1 to 13 in which the transmission unit is located remote from the prime mover.

15. A vehicle driveline comprising:-

a prime mover,

a first flywheel mass associated with the prime mover,

a continuously variable transmission unit,

a first driveline portion which connects the first flywheel mass with the transmission unit,

a main drive clutch,

a second driveline portion which connects the transmission unit with ground engaging drive means, and

torsionally resilient means operative in one of said driveline portions to damp torsional vibrations, shocks and noise therein, said torsionally resilient means comprising one or more speed sensitive linkages acting between relatively rotatable parts of said one driveline portion, the or each linkage including a centrifugal mass which tends to adopt a particular orientation when said one driveline portion rotates and which is displaced from said orientation against said centrifugal action when relative rotation occurs

between said driveline parts to provide a driveline with a torsional stiffness proportional to the speed of rotation of the driveline.

16. A driveline according to claim 15 in which a second flywheel mass is provided on the input side of the continuously variable transmission unit and said one or more speed sensitive linkages act between the flywheel masses.

17. A driveline according to claim 15 in which the first and second flywheel masses and speed sensitive linkages form a twin mass flywheel unit.

18. A driveline according to claim 15 in which the torsionally resilient means is provided in said driveline portion.

19. A driveline according to any one of claims 1 to 18 in which the second driveline drives two vehicle axles.

20. A vehicle driveline constructed and arranged substantially as hereinbefore described with reference to and as shown in figures 1 or 2 and 3 or 4 and 5 or 6 or 7 or 8 of the accompanying drawings.

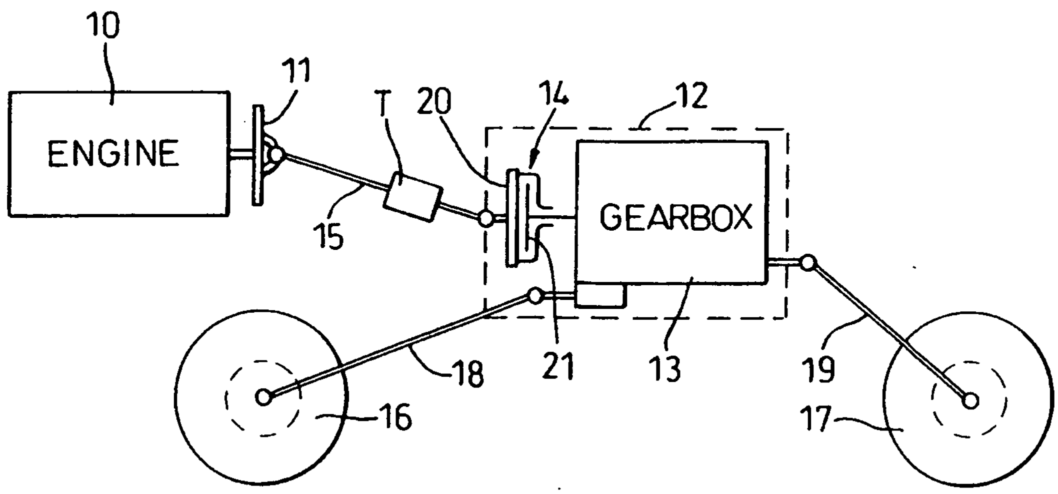


Fig. 1

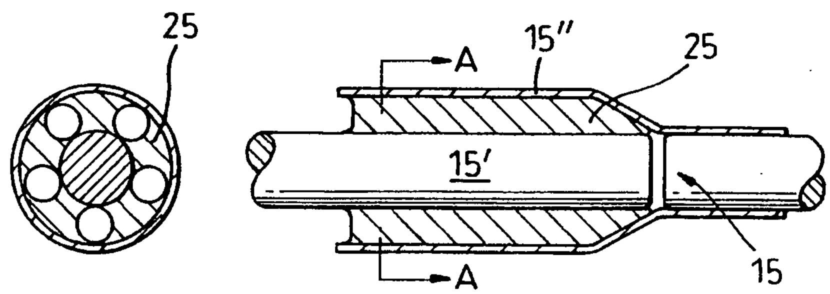


Fig. 3

Fig. 2

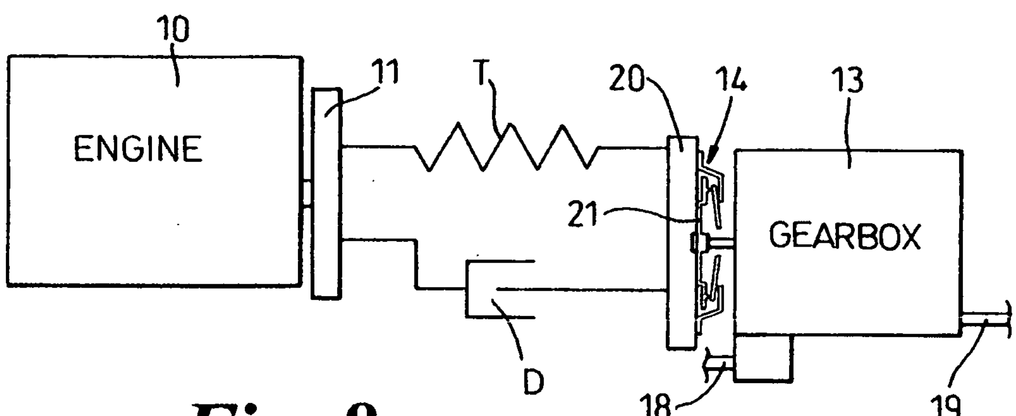
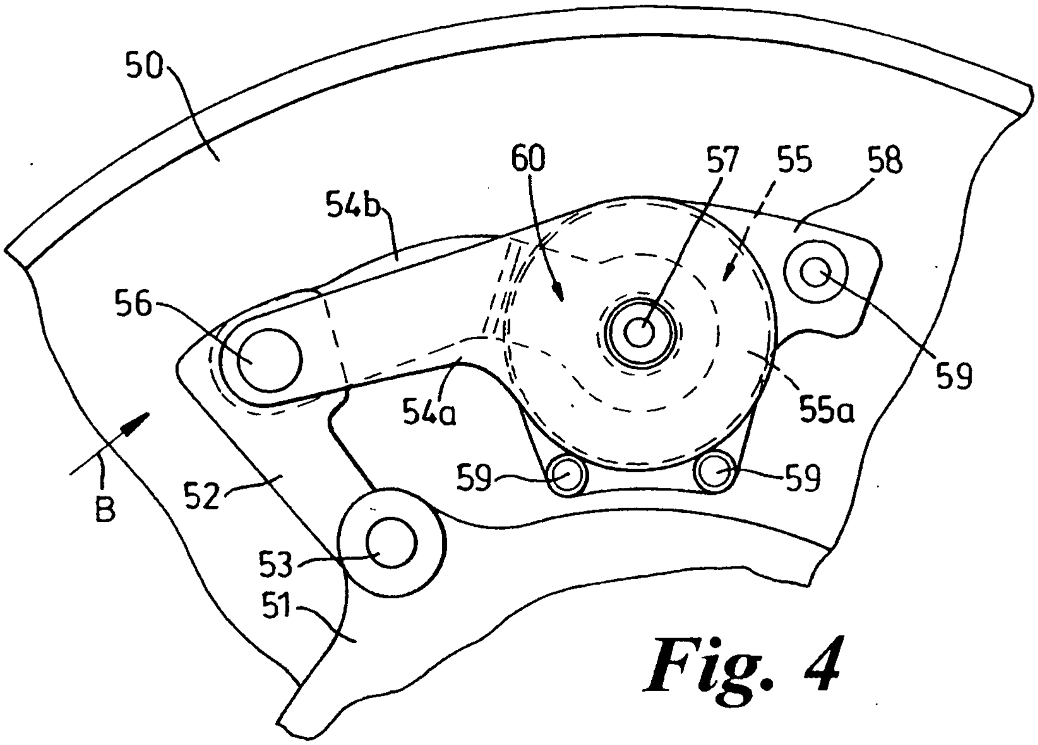


Fig. 8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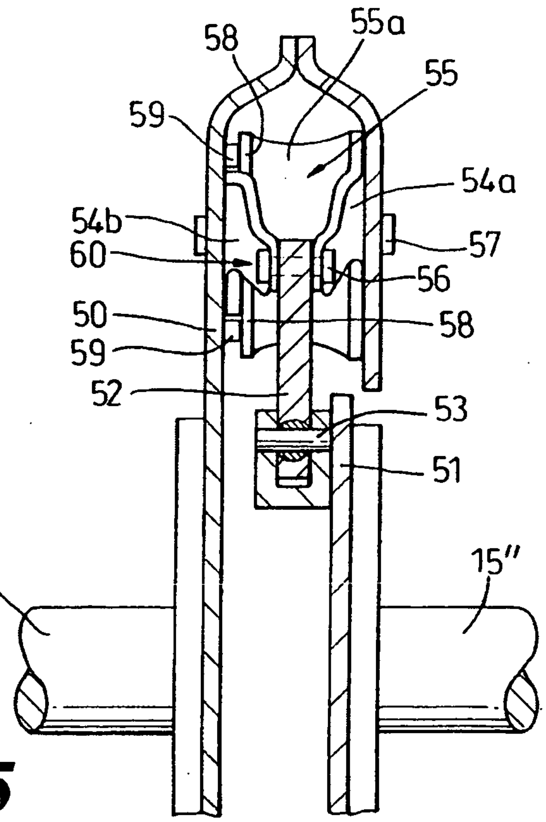
51

Fig. 4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15'
15"

Fig. 5

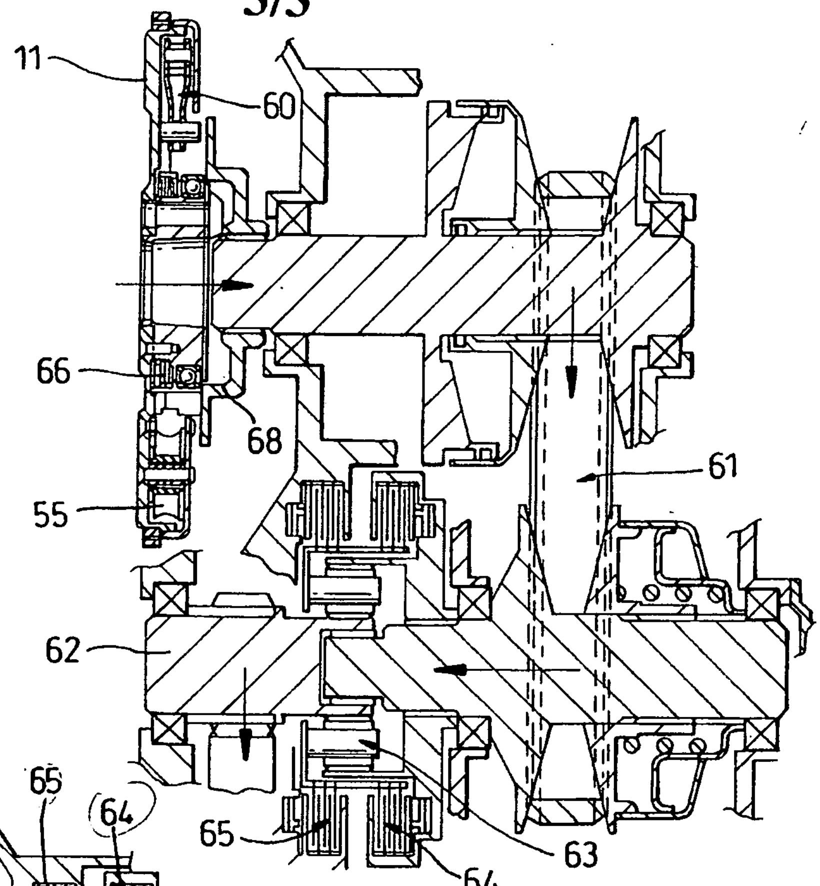

Fig. 6

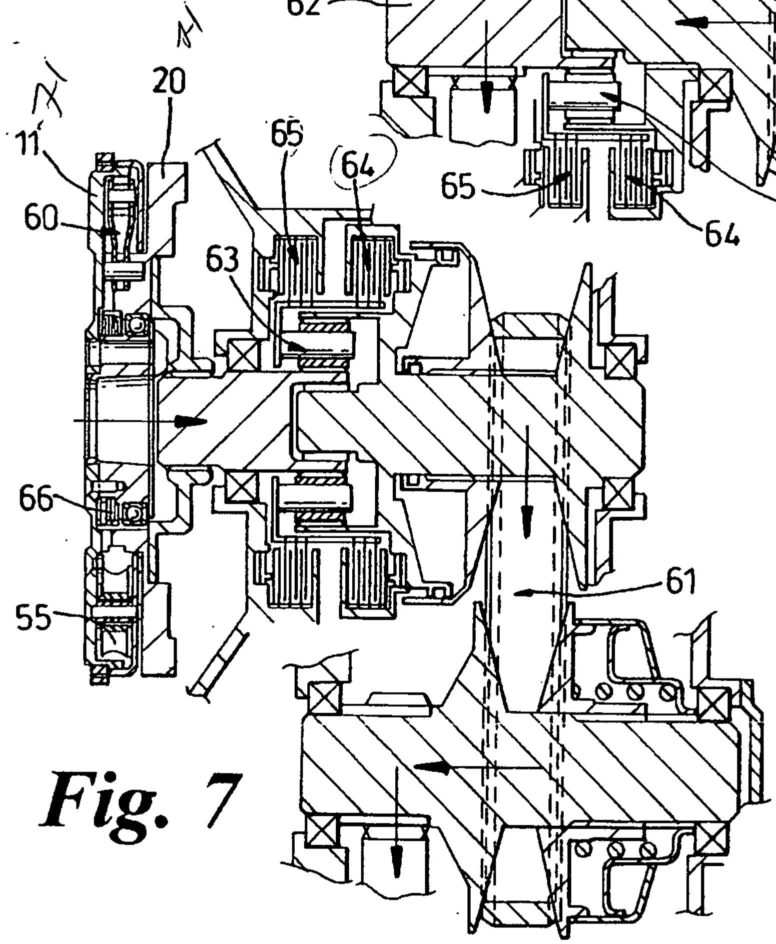

Fig. 7

DERWENT-ACC-NO: 1998-583772

DERWENT-WEEK: 200051

TITLE: Resilient torsional damper for use in motor vehicle transmissions - has a torsional damper, .i.e. a multi-plate frictional device, mounted between the flywheel and the transmission unit or in other drives in the transmission

INVENTOR: PATTERSON, I J; YOUNG, A J

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BASIC-ABSTRACT:

The transmission for a motor vehicle has a engine(10), a **flywheel**(11) connected to the engine, a transmission unit(12) with gearbox(13) and **clutch**(14), a first drive shaft(15) connecting the **flywheel** with the transmission unit and a second drive(18,19) transmitting drive to the road wheels(16,17).

A torsional damper(T) is included in the first of the drives to dampen torsional vibrations, shocks and noise, may comprises one or more speed sensitive linkages acting between relatively rotating parts of the drive. The torsional damper, which may be of a multi-plate frictional device, allows limited angular rotation between the two parts of the drive to provide damping. Torsional dampers may be included in other drive shafts in the transmission and for **drives in continuously variable** transmissions.

USE - Motor vehicle transmissions, provides improved noise and vibration suppression, may be mounted in parallel with other friction or viscous dampers,

suitable for continuously variable transmissions and for four wheel drive vehicles.

--------- KWIC ---------

Basic Abstract Text - ABTX (1):
The transmission for a motor vehicle has a engine(10), a **flywheel**(11) connected to the engine, a transmission unit(12) with gearbox(13) and **clutch**(14), a first drive shaft(15) connecting the **flywheel** with the transmission unit and a second drive(18,19) transmitting drive to the road wheels(16,17).

Basic Abstract Text - ABTX (2):
A torsional damper(T) is included in the first of the drives to dampen torsional vibrations, shocks and noise, may comprises one or more speed sensitive linkages acting between relatively rotating parts of the drive. The torsional damper, which may be of a multi-plate frictional device, allows limited angular rotation between the two parts of the drive to provide damping. Torsional dampers may be included in other drive shafts in the transmission and for **drives in continuously variable** transmissions.